



# Movable Furniture made of Water Hyacinth as Commercial Prototype

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The purpose of this research was to study the quality and production process of using water hyacinth to design movable furniture as commercial prototype. The methodology involved 3 parts namely: Part 1 Background of the work creation and its inspiration; Part 2 Analysis of the creation of work in the materials and furniture production process; and Part 3 Knowledge acquired from the creation of work and conclusions. The results showed that the optimum quality for preparing water hyacinths to make furniture was to moist sun-dried water hyacinths with water to become wet enough to tear into strips and dry in sunlight before weaving into patterns. Braiding in small or large sizes depended on the size of water hyacinth strips. The structure of chair was made with wood or rattan according to the predetermined designs. Water hyacinth braids were woven to wrap the chair structure, with the surface being finished with color paints or spray and left dry completely, and after that beautified with lacquer again. For the designs, there were 5 prototypes of commercial furniture that matched the market need which included 3 designs of easy chairs, 1 design of rocking chair, and a set of coffee table for coffee shop with 1 table and 5 stools.

**Keywords:** *designing water hyacinths furniture, commercial prototype*

## 1. Background and Significance

Water hyacinth is a weed that originated in the Amazon Basin of Brazil in South America. As a plant with a high growth rate, resistance to the environment, and the floats that can survive in both still and flowing water, water hyacinth propagates rapidly both by seeds and by budding. Its severe invasion has caused problems to various water sources throughout the country and also posed negative effects on the economy, society and the environment. With a very high growth rate, the biomass accumulation of water hyacinth was as high as 20 g. dry



weight per square meter per day with a maximum relative growth rate of 1.5% per day. Leaving them to grow in a water source starting from 500 g fresh weight per square meter in only 3 and a half months, water hyacinths can grow and propagate to produce biomass of up to 40,580 g fresh weight per square meter. In 1-year period, their growth is highest in April and lowest in January.

Thailand first brought in water hyacinth from Indonesia and it has quickly spread to various water sources across the country hence causing problems to those water sources in more than 64 provinces with the amount of over 5 million tons fresh weight per year. One plant of water hyacinth can produce up to 5,000 seeds. The seeds when in water sources can live for as long as 15 years. Water hyacinth propagates by budding. Two plants of water hyacinth can put forth leaves and grow up to 30 plants within 20 days or increase their weight 1 time within 10 days. It can cover the water surface at a rate of 8% per day. Releasing only 10 plants of water hyacinth in a water source, the number will reach 1 million within a year. The invasion of water hyacinth has been severe in the central plains especially in the areas of the Chao Phraya and the Tha Chin rivers. As water pollution caused by agriculture, wastewater from communities and industries, and wastewater from fish ponds and pig farms provided high nutrients for plants, hence promoting the rapid growth and spread of water hyacinth. A study found that only in the area of the Tha Chin River that about 2000 tons of fresh weight water hyacinth per day flow into the Gulf of Thailand.

The impact of the intrusion of water hyacinths in water sources and rivers has negative economic, social and environmental effects in the following areas. 1. Irrigation: Water hyacinths impede the achievement of water resources development as they slow down the water flow by about 40%, and obstruct the drainage through the water gate and shoal the water sources that need to be frequently dredged up. Importantly, water hyacinths causes water evaporation 3-5 times more than the area not covered with water hyacinth. In an area of 1m<sup>2</sup>, water hyacinth can evaporate water up to 0.35 m<sup>3</sup> per day, accounting for about 16,000 million m<sup>3</sup> a of water loss all over the country. 2. Electricity production: Water hyacinths reduce the lifespan of the dam due to their sedimentation that shoal the river and also reduce the amount of water due to 3-5 times more of water evaporation as mentioned before.

Using dried water hyacinth stalks to fabricate to form different designs of products were however found undesirable by the market because they were lacked of durability, beauty, and easily molded. Some of the products such as hammocks wasted a lot of raw materials and time to make while having low price with the return not worth the labors. The knowledge and skills were thus enhanced about how to dry the materials in sunlight and baking with sulfur. The trial of products being fabricated included for instances oval-shaped baskets and coasters. Today, the trend of "Global Preservation" has become so popular including even the furniture industries around the world that they begin to pay extra attention to the production of furniture so called the "Eco-Design" or environment-friendly furniture. It is important that



the eco-design furniture select materials and production methods that are not harmful to humans and the environment while decomposing easily so as to reduce waste in the environment and leaving no toxic residues in every part of the furniture. The emphasis was placed on recycling leftovers and decorating as new pieces of furniture with unique designs. The furniture business itself has also adapted in accord with the global warming. Many Thai designers started the eco-design furniture in response to this hugely popular trend of the current age. Suwan Kongkhunthian, a Thai designer with high reputation in establishing a business to export furniture made from water hyacinth under the Yothaka Company with a highlight of creating handicraft products made by Thai people. Every piece of their products is fabricated with exquisite craftsmanship. Additionally, their furniture was designed in simple shapes but perfectly blends of the Thai and modern styles together as one among the selling points contributing to their reputation, making the Thai products in the name of 'Yothaka' become famous and well-known in the global handicraft market. They decided to develop the designs every 5 years by seeking for new materials to make furniture particularly those that are environmentally friendly, for example, furniture made from pineapple fiber paper, Lipao grass (climbing ferns), synthetic fibers, etc.

With the significance noted above, the present project thus aimed to transform water hyacinth through the test process for efficient materials taken to design products that generate added value with the prototypes tested, and lead further to offer commercial benefits for the furniture industry group.

## **2. Objectives**

To study the quality and production process of bringing water hyacinth to design for movable furniture as commercial prototype in the furniture industrial crafts.

## **3. Material and Method**

Water hyacinth wickerwork is the adoption of local wisdom in weaving hampers, baskets, shoes, including large-sized furniture being made in households as a Thai way of life. The skills are applied and developed to use water hyacinth as raw material instead of bamboo strips and bamboo stalks. This uniqueness greatly attracts foreigners. The production process starts from preparing water hyacinth in various forms of such as braids, small strips, Pikul flower pattern, and crown pattern. The main materials and equipment include water hyacinth, rattan, needle nails, claw hammers, trim knives, awl, wooden plier, presser, lacquers, and basic hand tools for assembling furniture.

### **3.1 Preparation of water hyacinth strips**

3.1.1 Bring ready-to-use, sun-dried water hyacinth to dip into water to be wet enough to tear them into strips.

3.1.2 Tear water hyacinth into 3 - 4 strips; 3 strips for small and 4 strips for big

size of water hyacinth, with the soft stuff all removed.

3.1.3 Bring the strips in required numbers to dry in sunlight, make sure that they are dry enough before having them woven by the desired patterns.

3.1.4 If with natural color, the strips can be woven right away; if with dyeing, the strips need to be completely dried.



**Figure 1** Sun-dried water hyacinth braided for strong strips before fabricating in form.

3.2 Braid preparation (braiding) Cut the prepared water hyacinth into the desired length, soak them in water, and wrap them in a plastic bag to make it soft and leave it for a while; slit up the soft water hyacinth, 4 strips for the big-sized and 3 strips for the small sized water hyacinth, with the soft stuff all removed. If not removing the stuff, the braid will swell or puff up with resulted unfavorable braids. To make a braid, put together 3 strips of water hyacinth and interweave up and down into a braid in the same way as braiding hairs, and continue to the end. To extend the braid, attach a new strip to the shortest strip of the braid to make it longer while holding it tight to continue braiding for about 3 – 4 inch long and let go of the short one and grab the long strips to continue braiding. The size, small or big, of the braid depended on how small or big the water hyacinth was slit up into strips. Slit up big strips for a big-sized braid, and small strips for small-sized braid.

### 3.3 Dyeing water hyacinth

3.3.1 Soak into water about 1 kg of dried, slit-up water hyacinth with stuff all removed, for 1 hour to allow better color absorption, and brought them to half-dry.

3.3.2 Put about 10 liters of water into a pot or basin and bring to boil, then put 1 packet of dye (silk dye) in the pot of boiling water along with alum and 1 teaspoon of salt for color absorption and fastness.

3.3.3 Put the prepared water hyacinth into the pot of boiling water mixed with dye.

3.3.4 Try to stir well for the water hyacinth to dye all over, simmer for about an hour until the dye is thoroughly fast and frequently turn over water hyacinth for the dye to fast uniformly. Rinse the material until the water is clear without discoloration, and bring to hang on the cloth line to dry in sunlight before fabricating into products.

### 3.4 Weaving procedures

3.4.1 Create prototypes using woods to make furniture structure proportionately to functionality.

3.4.2 Plan for the weaving to wraps the wooden structure by installing water hyacinth warp to its full area and starting to weave on the armrests and the backrest, respectively.

3.4.3 Interweave water hyacinth wefts back and forth in the single cross pattern shown in figure 3 to complete the area.

3.4.4 Interweave water hyacinth to complete every side of the wood structure and patch up every detail.

3.4.5 Apply lacquer to prevent mold, moisture, and for beauty and easy cleaning.



**Figure 2** Weaving process for water hyacinth furniture started with the armrest, the backrest, to complete every side of the chair

**Prevention** The process to prevent the growth of mold in water hyacinth products are as follows. Clean dried water hyacinth with water and let them to half-dry, then soak them in a 3-5% solution of sodium benzoate for no less than 1 hour and let them dry completely in shade before using them to weave various types of products. During the weaving process, spray 0.1% solution of sodium benzoate instead of clean water to soften water hyacinth and make it easy to weave as well as to additionally prevent molds and after that have the product to dry completely, thus preventing the growth of molds for a very long time although in a high humidity environment. The amount of dried water hyacinth used was 1 kg soaked in a 3-5% solution of sodium benzoate (using 350 g sodium benzoate, 7 bowls of water or 14 bottles sized Mekhong whiskey bottle, stirred well to dissolve) (Petty Patent No. 151, Department of Science Service).

Guidelines for evaluating the outcomes are based on the community product standards for water hyacinth furniture (The Industrial Standards Institute: TISI. 402/2018). Water hyacinth furniture refers to the furniture obtained from bringing water hyacinth strips to go through the process of cutting, bending, joining, weaving, tying, knitting, assembling, polishing, decorating or others and attach them to a weight bearing structure as metal, synthetic or natural materials, either one or a combination, by using various materials such as wood,



rattan, metal, wire, nails, plant fibers, ropes to secure a form or shape as desired. It may include bleaching, coloring, coating with varnish, assembling or decorating with other materials for beauty such as cloth, artificial leather, etc. Water hyacinth strips that must be dried and may be exposed to sulfur or processed to prevent mold, then cut, split, or slide into strips of desired sizes, or may be flatten, braid or twisted, bleached or dyed.

Required features General features include fineness, sturdiness, stability, meticulousness, beauty, form and shape suitable for the use without distortion or sway, without molds or defects as a damage by moths, termites or other insects, without sharp edges and tips except as a distinctive feature of the work piece. The size of water hyacinth strips has to be consistent, soft, but not brittle, torn or broken. The work piece has no obvious flaw unless it exists naturally or is a distinctive feature of the work piece with no adverse effect at use. In the same collection, the designs, patterns, and colors need to be harmonic except for the specific character of the work piece.

The assembly is required to be neat, strong, meticulous, and beautiful without sharp edges and points except for the specific character of the work piece. The joint areas are clean and not separated. There are no cracks or tool marks resulted by the assembly, no smell of chemicals and stains of substances used as binder, including no nails and metal extending beyond the surface.

The pattern must be neat, beautiful, and consistent with precise, indistinct or seamless pattern connection following the original pattern.

The colors need to be smooth and even, tightly fast without taint, falling off, peeling off, or stain except for the specific character of the work piece, and also without color stain on hands when touch or contact.

Assembling or decorating with other materials is required to be neat, meticulous, beautiful, firmly attached, and suitable for the work piece. The joint areas are clean and not separated. There are no smell of chemicals and stains of substances used as binder, no sharp edges and points except for the specific character of the work piece. In case using natural materials, there is no mold or defect as a damage caused by moths, termites or other insects. There must be no rust if using metal, and no slinter or fin if using plastic.

The coating needs to be smooth and uniform without any grain, stain, crack, falling-off or peeling-off, to spoil the beauty of the work piece.

#### **4. Summary, discussion and recommendations.**

The knowledge gained from the creation of work was summarized in terms of the design with acquired 5 prototypes as commercial furniture that fit the market needs, namely: 1 design of

rocking chair; 3 designs of easy chair; and a set of coffee table with 1 table and 5 stools, altogether 10 pieces, as in the details follow.



**Figure 3** A sketch of rocking chair development. A drawing of chair structure made of rattan and real wood and wrap weaving with water hyacinth strips. The seat is with 10 cm. foam cushions for comfortable sitting, 2 armrests, 50 X 50 cm. wide in size, 45 cm high from floor to seat, 120 cm high from floor to backrest, and 112 cm long of the base rocking wood



**Figure 4** A sketch of easy chair development. A drawing of chair structure made of real wood and wrap weaving with water hyacinth strips. The seat is with 5 cm. foam cushions for comfortable sitting, 2 armrests, 40 X 40 cm. wide in size, 40 cm high from floor to seat, and 120 cm high from floor to backrest.

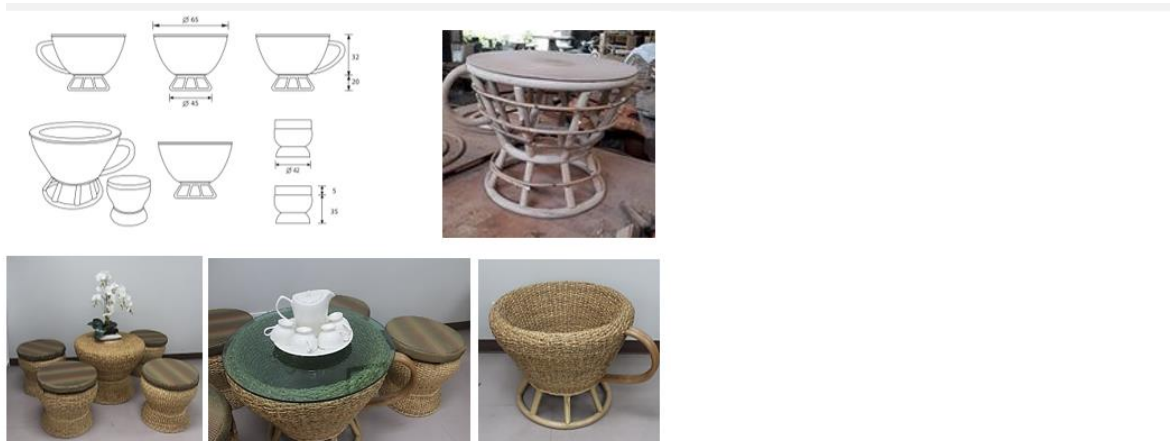


**Figure 5** A sketch of easy chair development. A drawing of chair structure made of real wood and wrap weaving with water hyacinth strips. The seat is with 10 cm. foam cushions for comfortable sitting, 2 armrests, 50 X 50 cm. wide in size, 40 cm high from floor to seat, 120 cm high from floor to backrest, adjusted declining degree, decorated with 6 lathed wood in ball-shape of 8 cm in diameter as an extra advantage for user's hand and foot massage to relax muscles.



**Figure 6** A sketch of easy chair development. A drawing of chair structure made of real wood and wrap weaving with water hyacinth strips. The seat is with 5 cm. foam cushions for comfortable sitting, 2 armrests, 40 X 40 cm. wide in size, 40 cm high from floor to seat, and 87 cm high from floor to backrest. cm.





**Figure 7** A sketch of developing a coffee table set with 1 table and 5 stools. A drawing of table structure made of rattan and plywood and wrap weaving with water hyacinth strips. Each stool is with 10 cm. foam cushions, 42 cm in diameter, 40 cm high, and 40 cm high from floor to seat. The table is 60 cm in diameter with a glass plate of 65 cm in diameter on top.

Cleaning not so dirty furniture can be easily done by using a feather duster to clean off dust. For stains or dust starting to stick or set on the furniture, clean clothes can be used to wipe on the furniture to prevent the dust from setting deeper into the furniture and to avoid frequent big cleaning. When wiping with clean, damp cloth and again with dry cloth, the furniture should be dried in sunlight, choosing a strong sunny day to make sure the furniture is completely dry and free from damp. To get rid of insects, kerosene or DDT can be sprayed into the holes dig by snout beetles with repeated application until none of them are left observable. The furniture should be placed properly in the areas with relatively low humidity and away from water sources, wet garden or the bathroom area. The proper place include such as living room, bedroom, stairway corner. The further away from the area with high humidity, the longer the life of furniture will extend.

Investigation of related research pertaining to the use of water hyacinth for value added, Aungkab Boonsung (2016) studied about the network of community basketry crafts in Uttaradit as an operational research focusing on 4 groups including Na In hats weaving group; Tao Hi Nuea agro-housewife group; water Toongsetthi water hyacinth craft products group; and Nam Pad bamboo hats weaving group. Results suggested several areas of potentials of the basketry crafts community of Uttaradit including (1) Cultural capital from the local weaving wisdom; (2) Social capital from the gathering of community people; and (3) Natural resource capital from biodiversity. Community members shared and integrated their potentials to establish a “basketry crafts community network”. For the group to be constantly developed and strengthen required the following elements: strong leader, clear targets, respecting rules and regulations, shared learning, shared resources, collective activities, sense of brotherhood, and trust. Participation in doing activities led to good



relationship, understanding, and care for each other, and hence giving rise to 4 networks of the basketry crafts community network of Uttaradit as desired by members. They included material purchase network; information network; learning network; and distribution network for groups in Uttaradit, resulting in increased capacity of the basketry crafts community. Ampai Sangjanthai and Jirawat Phirasan (2015) conducted a research on developing furniture from water hyacinth of Ban Wongkong Water Hyacinth Basketwork Club, Lankrabue District, Kamphaengphet province with the objectives to study the production process and development of furniture from water hyacinth and consumer satisfaction toward the new designs of water hyacinth furniture. Results reported the guidelines for developing product prototypes by the designs in geometric shapes, determining the size proportionately to human physiology focusing on functionality. Result of evaluation by specialists on the standards of furniture product prototypes and on consumer satisfaction towards the development of water hyacinth furniture prototypes were at a highest level. Nagrittika Supphong (2021) carried out a research on public participation in conservation of water hyacinth basketry work, a case study in Sappaya District Sapphaya District, Chainat Province. The results found that the participation level was at a moderate level in overall. For individual aspect, the participation was at a highest level ranked from high to low as shared benefits, decision-making evaluation, and the operation, respectively. The results of the hypothesis testing of the differences between personal characteristics found that people with different sex, age, occupation, marital status, education level, and income had different levels of participation. Participation in the conservation of water hyacinth basketry should focus on developing modern product designs, developing creative craftsmen, continuously searches for suitable production techniques and processes, providing knowledge on raw material management to reduce the risk of loss, including the diverse and modern distribution channels to suit the target groups of current age. Regarding the commercial production of water hyacinth products, Nittaya Wongyos (2021) conducted a research on the marketing mix affecting product purchasing decisions of the hyacinth basketry group in Muang District of Phayao province which was conducted using questionnaire in a sample of 380 general people who bought water hyacinth products in Muang District of Phayao Province. It was found that consumers' purchasing decision by the product diversity, product distinction, design, quality, color and beauty were at a high level.

Recommendations from the present research are that knowledge enhancement should be promoted among those entrepreneurs on the following 4 areas. 1. Water hyacinth products should focus on the design, color, and pattern that suit and match the demand of consumers, for example, modern look designs to fit with different styles of home decoration, the sizes of furniture following the proportion, height, width, and depth of international standards, promotion of furniture designs in different types such as bed, closet, sofa, accessories for buildings decoration so as to create value and develop quality products to be well-known among consumers. 2. Price should be determined by the quality of water hyacinth products which may be defined in many levels to allow consumers to choose from as desired.



Discounts may be offered or bargaining is allowed to satisfy customers but bringing no loss to product makers, taking into account the materials and patterns for the price to fit with functionality and purchasing power of consumers. 3) Place for product distribution should be set up in the form of a center for selling water hyacinth products located at tourism sites in provinces, making it convenient for consumers to easily reach and buy. 4) Marketing promoting should focus on market expansion by selling products to consumers in other provinces or by exporting. Involved agencies should act on marketing promotion to make known of water hyacinth products through public relations, information, and the internet, for example.

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